Steel Success Story

Novel Technology Yields High-Quality Iron Nuggets

Steel manufacturing involves many energy-intensive steps to process raw or recycled materials, such as iron ore and scrap metal. Global competition requires steelmakers to apply new technologies that can produce high-quality pig iron with lower capital and manufacturing costs, faster production times, and reduced emissions.

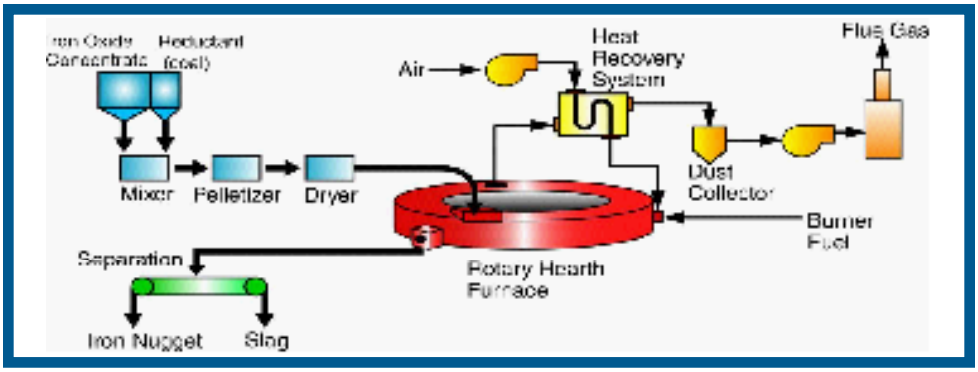
Pig iron is traditionally produced in the blast furnace, but environmental regulations, aging furnaces, and plant shutdowns have reduced production capacity and increased prices. Growing global demand for scrap has also caused scrap prices to increase sharply. These price increases and supply problems have created the need to develop metallic iron sources other than pig iron and scrap.

The U.S. Department of Energy's Industrial Technologies Program (ITP) has supported refinement of a remarkable new process for making iron. The ITmk3® process has the potential to revolutionize ironmaking. This process is capable of using low-grade ore to produce iron nuggets superior in quality to direct reduced iron (DRI) and similar in quality to pig iron. The iron nuggets are suitable for use in electric arc furnaces (EAF), basic oxygen furnaces (BOF), and foundry applications. The project equity partners are planning to build the first commercial demonstration facility at Hoyt Lakes, Minnesota. It is anticipated the facility will be in operation by late Spring 2008 with an iron output of 500,000 metric tons per year.

New Technology Uses Rotary Hearth Furnace to Produce High Quality Iron Nuggets

The Mesabi Nugget Project is a large-scale pilot demonstration of the innovative ITmk3® ironmaking technology developed by Kobe Steel for the North American steel industry. The ITmk3® process uses a rotary hearth furnace to rapidly turn iron ore fines and pulverized coal into nuggets of high purity (96-98% metallic iron content). Reduction, melting, and slag removal occur in only 10 minutes as compared to hours for the traditional blast furnace process.

Process Flow of ITmk3®



ITmk3® process flow sheet reveals a one-step furnace operation.

The ITmk3® Process in Brief:

- High nugget purity with up to 98% metallic iron content
- Potential 30% energy savings over current three-step process for integrated steelmaking
- Potential 10% energy savings when used in EAF steelmaking
- Environmentally friendly process potentially reduces emissions by more than 40%
- Produces high-quality iron without coke and agglomeration steps
- Excellent operational reliability
- Utilizes low-grade ore
- FeO reduced to less than 2%, minimizing attack to refractories
- Gangue-free nuggets
- Low capital and operating costs
- Iron nuggets suitable for use in all melt shops at BOF, EAF, and foundry operations

Project Equity Partners

Mesabi Nugget, LLC
Silver Bay, MN
(Principal Investigator)

Ferrometrics, Inc.

Cleveland-Cliffs

Kobe Steel

Steel Dynamics, Inc.

Iron Range Resources

Other Stakeholders

Minnesota Department of Employment and Economic Development
St. Paul, MN

Technical Accomplishments

The Mesabi Nugget Project is part of a DOE *Grand Challenge* R&D effort. It holds the potential to produce dramatic improvements in energy efficiency, environmental performance, and product yield. The project entails the operation of a pilot plant to demonstrate and optimize the new ironmaking technology and to confirm the benefits of the process in North America.

ITmk3 Pilot Demonstration Plant

- Produces high-quality, iron nuggets (96-98% metallic iron content)
- Achieved four individual production months with availability in excess of 93% and two months at 99%
- Produced iron nuggets at an average monthly production rate of 1,764 tons
- Successfully processed a variety of iron ores and materials, including eastern coals and Powder River Basin coal. Western coals and western Canadian high-carbon coals will also be tested
- Successfully recycled key process materials
- Operated continuously for at least 80 days

Iron nugget performance in a modern EAF steel making melt shop

- At 30% scrap usage, emissions reductions are greater than 40% for all emission components considered: CO, NOx, PM10, SO_2, VOC and CO_2
- Improved iron output
- Excellent operational reliability

Commercialization Activities:

- Iron nuggets currently purchased by Indiana steelmaker, Steel Dynamics
- Construction of first commercial 500,000-ton annual capacity plant begins Fall 2006 in Hoyt Lakes, Minnesota
- Plans also include construction of two or more production facilities in Minnesota, totaling 1.65 million tons annually

Iron Nuggets from the Pilot Plant

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References

Mesabi Nugget Research Project Final Report, DOE Award No: DE-FC36-02ID14280

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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1-877-EERE-INF (1-877-337-3463)
www.eere.energy.gov

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